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Linear regression analysis showing the predictors of mortality in COVID-19

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A B S T R A C T

To quantify the role of age, gender, exposure and rate of infection as predictors of mortality in corona virus disease 2019 (COVID-19), a cross sectional study was conducted covering 219 patients who were tested positive out of 554 suspects in Qazi Hussain Ahmed Medical Complex Nowshera, Pakistan. Linear regression analysis was used as a statistical tool. We observed that the positive contact history/exposure has been shown to have strong predictive value for mortality due to COVID-19 *(β=0.394**, ΔR^2=0.011, p=0.001).* Similarly, age>60 years and rate of infection were also strong predictors of mortality with interaction values of *(β=0.389**, ΔR^2=0.046, p=0.001)* and *(β=0.431**; ΔR^2=0.005, p =0.03)*, respectively. Gender as such is not a statistically significant predictor in mortality due to COVID-19. We concluded that using this regression analysis: the age of patients and positive exposure irrespective of gender statistically predicts the mortality in COVID-19.

Introduction

Corona virus disease 2019 (COVID-19) was first reported from metropolitan city, Wuhan, Hubei province of China in Dec 2019, that causes severe respiratory disease/pneumonia. The etiology of COVID-19 is yet to be confirmed, but majority of the scientists agree that it most likely originated from the zoonotic corona virus, Severe Acute Respiratory Syndrome coronavirus (SARS-CoV) that emerged in 2002 [1].

Corona Virus disease termed as COVID-19, is an emerging highly contagious respiratory disease that is caused by novel corona virus. Its main clinical symptoms are fever, dry cough, fatigue, myalgia and dyspnea. Case fatality rate of 2.3% has been reported from china that is lower than SARS (9.5%), Middle East Respiratory Syndrome (MERS) (34.4%) and Hemophilus Influenza (39%) [2].

In Pakistan the literature so far covering the prevalence and incidence is deficient. In Pakistan the so far (24th July 2020) reported data from government sources declares 270,400 confirmed cases with 5763 deaths. 219783 cases are recovered so far, and 1316 cases are under treatment in high dependency units countrywide. Sindh is the province with highest number of corona cases crossing 115883 [3].

Qiu H et al [4] reported from the infected zone of China that strong suspects from among the family members and other close contacts of COVID-19 patients, the infectivity ratio was as higher as 89% while it was (33%) for history of exposure to epidemic areas. Regarding mortality in age groups a study from China

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reported 80% of the causalities (deaths) due to COVID-19 were in the adults aged >60 years [5].

Objectives of the study and Methods

To quantify the role of age, gender, exposure and rate of infection as predictors of mortality in COVID-19, we did a cross sectional study covering 219 patients who were tested positive out of 554 suspects in Qazi Hussain Ahmed Medical Complex Nowshera, Pakistan from 10th March to 20th July 2020. Linear regression test was used using SPSS version 25 with task to predict a positive link of dependent variable, input (like infection (test positivity, exposure) with independent variable, output (Mortality) in COVID-19.

Results and Discussion

We observed that the positive contact history/exposure has been shown to have strong predictive value for mortality due to COVID-19 as supported by the regression analysis. Beta value, i.e., *(β=0.394**),* showed that there was a positive link between exposure and mortality due to COVID-19 and oneunit increment in the exposure will cause a 39.4% increment in the rate of mortality due to COVID-19. The value of R^2, i.e. *(R^2=0.011),* shows that exposure is accounted for the variability of 1.1% in the cases of mortality. The p-value which is *(p=0.001),* supported the statistically significant relationship **(table 1)**.

Similarly, **Anzai A et al** [6] reported 33% of the infectivity in suspects with strong contacts but not with a contact directly COVID-19 patient. **Shi Y et al** [7] reported from Wuhan city, a significant relation of close contacts gets more infected from family members *(p = 0.031)* with COVID-19 that strongly supports our findings.

Mortality due to COVID-19 positively moderates with rate of infection supported by the results of an interaction term with *(β=0.431**; ΔR²=0.005, p-value=0.03).* The stated results showed that rate of infection positively associates with case fatality due to COVID-19 **(table 1)**. Italy has been worst hit by the COVID-19, measuring 185000 cases mostly reported from the northern cities of the country. By April 2020, 45% increase in deaths were registered with a higher number being reported from the north of the country (76%) of the total. Most of them were men with an increasing trend by age with a mortality rate of 7.2% [8,9]. The severity of the infection has an impact on mortality rate. A study reported from Wuhan, the epicenter of the first outbreak reported mortality in positive patients as higher as 20% [10].

Mortality due to COVID-19 positively moderates with age>60 supported by the results of an interaction term with (*β=0.389**; ΔR²=0.046 and P value=0.001*). We concluded in one other intervention published in Microbes and infectious disease (MID) that the rate of infectivity and exposure to come across in contacts with positive patients with a probability of 2 times more than in people with age<55 years *(p=0.005, OR=2.01)* while the case fatality was three times more in patients with age >55 years *(p=0.001, OR=3.16).* The mortality rate was 5.41% [11].

Regarding the gender effect we observed that one unit increase in male gender exposure will cause 1.1% increase in rate of mortality as compared to female gender, which shows no clinically and statistically significant difference in gender groups *(β=0.011; ΔR²=0.001, p=0.11)* **(table 1)**. However, the literature from Italy reporting the infection being more common in male gender as compared to female gender with a higher mortality in the patient with age> 60 years [9]. The age vs mortality graph shows majority of the deaths occurred at age> 50 years **(figure 1)**.

Hence we concluded that using this regression analysis we observed that age of patients, and positive exposure irrespective of gender statistically predicts the worst outcome in term of death in COVID-19 and this must be considered by the treating physician and treatment strategies should be age and risk exposure based to have hope for better outcome in COVID-19.

Therefore, in future it is the need of time to better understand the impact of gender and age in COVID-19 and to tailor the treatment according to the age and gender perspective and the therapeutic trials must include gender sensitive analysis.

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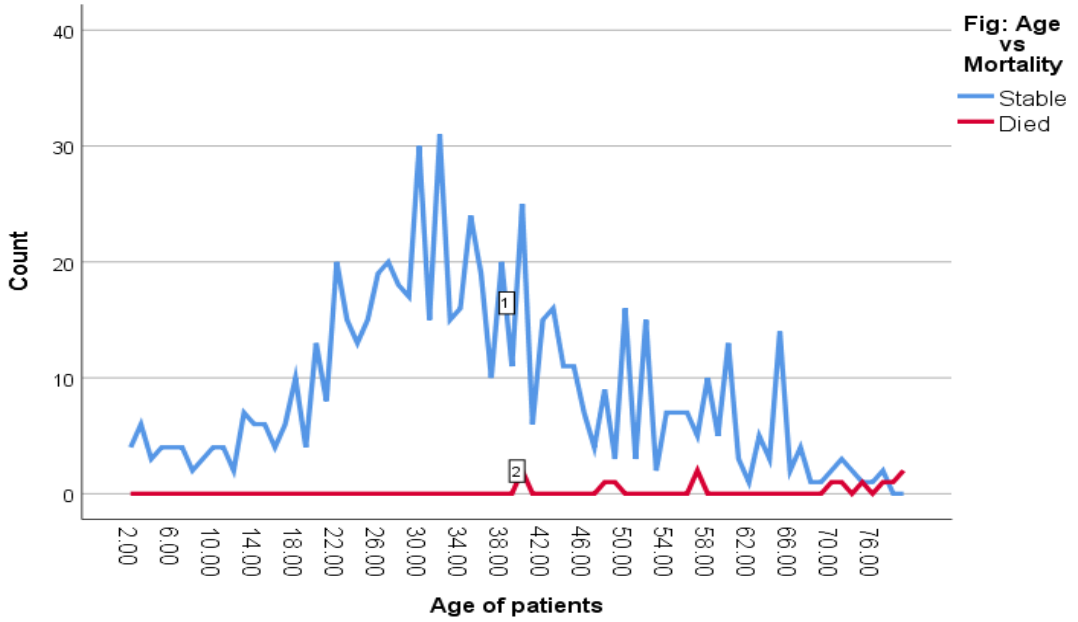
Table 1. Linear regression analysis to predict mortality in COVID-19 again different variables like age, gender, exposure and rate of infection.

Name of predictor	B (β-value)	ΔR2 (Variability)	Significance
Positive Contact History	0.394**	0.011	*0.001*
PCR Positivity (Rate of infection)	0.431**	0.005	*0.03*
Age >60 years	0.389**	0.046	*0.001*
Male gender	0.011	0.001	*0.11*
Significance at p=0.01**, Significance at p=05*			

Figure 1. Age vs mortality graph.



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